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Case Report

Application of peritoneal dialysis in an infant with fungal sepsis-induced acute kidney injury

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Abstract: Acute kidney injury (AKI) threatens the neonates and small infants' life. Peritoneal dialysis (PD) is the first choice of renal replacement therapy for neonates and small infants with AKI. Because the abdominal wall structure development of neonate or small infant is not mature, the requirements of the operator's technical level are relatively high. Literature in this area is scarce, especially in China. In this study, we report the application of PD in AKI secondary to severe fungal septicemia in a 41-day-old premature-birth infant from China. Furthermore, we briefly review rare existing case reports documenting the application of PD in neonates and small infants with AKI.

Keywords: Acute kidney injury, infant, neonate, peritoneal dialysis

Introduction

Acute kidney injury (AKI) is an important risk factor for neonates and small infants [1]. Causes of AKI include premature birth, infection, gastroenteritis, together with primary kidney disease [2]. Renal replacement therapy is often considered a last resort when all other medical management has failed. Due to the difficulty for establishing a vascular access in neonates and small infants, the application of hemodialysis is limited. Therefore, peritoneal dialysis (PD) is the first choice of renal replacement therapy for neonates and small infants with AKI [3, 4]. Moreover, PD seems to have a theoretical advantage in neonates and small infants due to the large peritoneal surface area to body ratio which is related to an ideal dialysis efficacy [5]. However, the abdominal wall structure development of neonate or small infant is not mature and the requirements of the operator's technical level are relatively high. Literature in this area is scarce [6-8], especially in China. In the present paper, we report details of one case of severe fungal septicemia-induced AKI in a 41-day-old premature-birth infant from China, and discuss the application of PD.

Case report

The patient is a male premature infant (33 weeks, +3 days) under caesarean section, with the birth weight of 2190 g and Apgar scores of 8 and 9 in 1 minute and 5 minutes, respectively. On day of life (DOL) 35, the infant was taken back to the hospital because he refused to be fed and the response was poor. After physical and laboratory examination, the infant was diagnosed as fungal sepsis and received antifungal therapy with fluconazole. On DOL 38, the infant represented hypourocrinia (urine volume, UV 0.71 ml/Kg·h) and renal dysfunction (serum creatinine, SCr 348.0 μmol/L; blood urea nitrogen, BUN 15.09 mmol/L). The infant was considered as AKI and was given appropriate fluid infusion and diuretic treatment. On DOL 41, the infant was anuric and appeared systemic edema and more serious renal failure (SCr 461.6 μmol/L, BUN 21.17 mmol/L). Even worse, the serum potassium climbed to 7.24 mmol/L which was a serious threat to the infant's heart function. Considering the getting worse kidney function and serious hyperpotassemia, the infant was given catheter implantation and initiation of peritoneal dialysis treatment.

Figure 1. Photograph of peritoneal dialysis catheter placement.

The specific methods are as follows: The infant lay on the operating table and got disinfection. After that, the infant was anesthetized by the application of fentanyl. A paramedian surgical incision was made in the left upper quadrant (**Figure 1**). Subcutaneous tissue was separated bluntly and sharply to the posterior rectus sheath. Taking into account the thin rectus and both its anterior and posterior sheaths, a purse suture was performed directly on the three-layer tissue surrounding the insertion point. The peritoneum was open and a double-cuff, Tenckhoff straight catheter (Covidien, 30 cm length) was inserted with a guide wire into the abdominal cavity and directed into the pelvis. As the deep yellow ascites flowed out through the catheter in a linear fashion, the purse was tighten and ligated under the deep-cuff without leakage. A subcutaneous tunnel was made using a puncture needle with the shallow-cuff just in the exit-site (**Figure 1**). Then an external tube was connected to the catheter. Subcutaneous fat and skin were sutured. After this operation, intermittent peritoneal dialysis (IPD) treatment was initiated. Each PD solution (Baxter, 1.5%) infusion volume was 60 ml and the dwell time was 2 hours. Ten circles per day were made manually.

With successful dialysis, the UV was increased gradually and kidney function was improved. Detail information was list in **Table 1**. No catheter-related complications were observed during the treatment.

Discussion

Lack of appropriate equipment and technology for the small infants limits the application of PD which is a potential treatment strategy to save lives of patients with AKI [9, 10]. Standard cuffed PD catheters are too long for a small infant's abdominal cavity. However, there are few reports of suitable PD catheters for neonates and small infants. In a low-birth-weight neonate weighing 830 g, Harshman et al. performed PD to treat AKI [6]. By using the Seldinger technique, the 8.5-French, 8-cm commercial temporary PD catheter was successfully implanted into the abdominal cavity. However, the catheter related complications were not recorded in this study [6]. In another study, a single-cuff, straight Tenckhoff catheter was successfully placed in two extremely low-birth-weight neonates (630 g and 700 g, respectively) with AKI. However, minimal leakage was observed in both of these two patients due to the large caliber of Tenckhoff catheter [8]. To reduce the catheter caliber and increase the flexibility, vascular catheter was reported to take over from Tenckhoff catheter and temporary PD catheter in neonates with AKI [8, 11].

In our study, at the time the operation was taken, the bodyweight of the infant was increased to 3040 g, which was bigger than that in above studies. Moreover, considering the soft Tenckoff catheter was better than the hard acute PD catheter [12], and suitable for neonates and small infants [8], a double-cuff, pediatric PD catheter was chosen in our study. Since our infant was relative bigger than that in previous studies (3040 g vs. 630-830 g), a subcutaneous tunnel was made, which is important for fixation of catheter and prevention of infection. Transparent protein adhesive which was suggested to prevent leakage [13] was not used in our study, and no leakage occurred.

Table 1. Changes of the infant after IPD treatment

DOL	Edema	UV (ml/Kg)	sCr (μmol/L)	BUN (mmol/L)	Potassium (mmol/L)	UFV (ml/day)	PD status
41	+++	0	461.6	21.17	7.24	-	Start IPD
42	++	0.02	444.3	18.67	4.52	199	IPD
43	+	3.5	405.2	16.21	3.28	97	IPD
45	+	3.6	252.5	12.89	3.43	75	Stop IPD
48	-	4.8	108.7	5.27	3.98	-	Pull out the PD catheter
56	-	5.3	58.6	2.73	3.77	-	-

Blood urea nitrogen, BUN; Day of life, DOL; Serum creatinine, SCr; Urine volume, UV; Ultrafiltration volume, UFV.

Automated PD (APD) is suitable for management of pediatric AKI with the exception of low-birth-weight neonates and small infants where fill volumes are too small for currently available machines. Therefore, manual replacement of the PD solutions by gravity, as we did in present study, was recommended for children and infants [14, 15]. To decrease the risk of infection, the liquid exchange system must be closed. Additionally, to decrease the risk of abdomen excessive swelling-induced leakage, accurate control of liquid volume was necessary. According to the above, buretrol was recommended by International Society for Peritoneal Dialysis (ISPD) to keep liquid equilibrium for children and infants [15]. However, the twin-bag system was chosen in our study since we didn't have buretrol. Liquid equilibrium control was good and no infection occurred.

Besides hyperpotassemia, this infant also presented fluid overload which increased the risk for morbidity and mortality in AKI patients [16]. The successful generation ultrafiltration is an important treatment goal for these patients. Compared with CAPD, IPD can achieve a better effect of ultrafiltration and result in resolution of the fluid overloaded state, since free water removal is greatest during the first 1-2 hours of each exchange. Moreover, to achieve positive ultrafiltration and meet the patient's needs, hypertonic dialysis solutions (2.5% or 4.25%) are usually required. It is noteworthy that rapid cycling with hypertonic dialysis solutions to promote ultrafiltration can lead to hypernatremia which is a result of enhanced free water clearance secondary to sodium sieving and transport of water through aquaporin channels [17, 18]. Considering these, for this infant in our study, IPD with 1.5% osmolality dialysis solutions was performed continuously throughout the full 24-hour period for 4 days. We were glad to see that hyperpotassemia, renal dysfunction and fluid overloaded state were obviously improved, and hypernatremia didn't happen during the treatment period. Another problem we must consider is the volume for each cycle.

In summary, we reported a case of AKI in a 41-day-old premature-birth infant from China. We also introduced and explained the prescription of PD in our study. We hope our successful experience will further boost confidence to the application of PD in infants with acute kidney injury, especially in China.

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Disclosure of conflict of interest

None.

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